

MOBILE COMMUNICATION SYSTEM AND BASE STATION FOR USE THEREIN

BACKGROUND OF THE INVENTION

The present invention relates to a mobile communication system, and more particularly to a control technique for transmission power of the base station to reduce inter-channel interference in mobile communication systems.

In a mobile communication system, the base station transmits to a plurality of mobile terminals signals of speech, data or the like over channels which are set before the start of communication. In such a system, when a mobile terminal moves, the condition of reception of the electromagnetic wave from the base station changes.

As the reception power level of the desired wave drops, reception becomes more susceptible to interference from waves on other channels, making it probable for data from the base station to become unable to be correctly received by the mobile terminal. Therefore, the mobile terminal requests the base station to increase its transmission power to maintain the quality of reception. Or, conversely, if the level of the reception power of the desired wave from the base station increases more than necessary, the mobile terminal requests the base station to reduce its transmission power in order to prevent its desired wave from interfering with other channels. Such a transmission power control technique for the base station is disclosed, for example, in the Gazette of the Japanese Patent Laid-open No. 1989-49336.

FIG. 1 is a block diagram illustrating the mobile communication system described in that reference.

As shown in the diagram, the station is provided with a transceiver (TRNC) 11 and a transmission power control unit (PCONT) 31 for channel 1, a transceiver 12 and a transmission power control unit 32 for channel 2, and a transceiver 13 and a transmission power control unit 33 for channel N. The base station is further equipped with an antenna 15 to transmit signals from each transceiver to mobile terminals and to receive signals from the mobile terminals.

Each mobile terminal is provided with an antenna 16, a transceiver 17 for receiving signals from the base station via the antenna 16 and transmitting signals to the base station via the antenna 16, and a receiving condition detector (DET) 18 for detecting the condition of reception of the electric wave from the base station.

First will be described the operation of the mobile terminal. Signals of speech, data or the like from the base station is received by the antenna 16, and conveyed to the transceiver 17. The transceiver 17 demodulates the receive signals. The receiving condition detector 18 evaluates the condition of reception by detecting the error rate of demodulated signals, signal-to-interference ratio (SIR) of the receive signals or reception power and the like. If the detector finds the quality of the received signals low or unnecessarily high, it instructs the transceiver 17 to send to the base station a signal requesting the base station to change its transmission power. In response to this instruction, the transceiver 17 transmits a transmission power instruction signal, together with speech, data or the like to be transmitted to the base station, via the antenna 16 to the base station. This transmission power instruction signal contains information on how much the transmission power is to be increased or decreased.

Next will be described the operation of the base station.

The base station, using one or more channels, transmits signals of speech, data or the like to mobile terminals. For

this purpose, each of the transmission power control units 31, 32 and 33 controls transmission power on one or another channel. Signals on each channel are multiplexed and transmitted from the antenna 15.

Since the operation is all the same on any of channels 1 through N, the following description will refer to channel 1 alone. The transmission power control unit 31 for channel 1 determines how strong the power be used for transmission from the transceiver 11 for channel 1 should be according to a transmission power instruction signal C1, and gives the determined value to the transceiver 11 as transmission power control signal P1 for channel 1. However, if the determined value is above the upper limit of the range of the transmission power of the transceiver 11 for channel 1, the maximum value will be given as transmission power control signal P1. If the determined value is below the power limit of the range, the minimum value will be given as transmission power control signal P1 for channel 1.

The transceiver 11 for channel 1 transmits signals of speech, data or the like, which are desired to be sent, at a level of transmission power according to the transmission power control signal P1 for channel 1. The same operation takes place on channels 2 through N, and signals desired to be sent by electromagnetic wave are transmitted from the transmission/reception antenna 15 of the base station.

The wave emitted from the transmission/reception antenna 15 of the base station is received via the transmission/reception antenna 16 of a mobile terminal by its transceiver 17. The receiving condition detector 18 monitors the conditions of the reception power and detected signals at the transceiver 17, and generates a signal to instruct an increase or a decrease of the transmission power of the base station according to the SIR or the error rate after detection. This signal, either built into a main signal or over another independent channel specially available for the purpose, is transmitted from the mobile terminal to the base station. At the base station, the transceivers 11, 12 and 13 separate this signal and obtain transmission power instruction signals C1, C2, . . . , CN.

By prior art systems, if the SIR of one channel falls below or the error rate rises above respectively prescribed levels, control is effected so as to increase the transmission power of the base station. This invites increased interference with other radio communication apparatuses, i.e. other channels. This tendency is particularly conspicuous in code division multiplex access (CDMA) systems for mobile communication, in which many channels share the same frequency.

In consequence, at any mobile terminal suffering increased interference, the increased interfering waves invite a drop in SIR and a rise in error rate. If the SIR drops or the error rate rises above respectively prescribed levels, the mobile terminal using the channel suffering interference will be obliged to request to strengthen the base station transmission power, and may thereby increase its own interference with another channel or channels. In this way, requests for increased transmission power on the part of the base station arise from a plurality of channels, and the transmission power of the base station might reach its maximum, inviting an expanded region of interference.

SUMMARY OF THE INVENTION

According to one aspect of the present invention, there is provided a base station for use in a mobile communication system in which a base station and a plurality of mobile terminals communicate with each other over preset commu-